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मानक

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IS 6818 (1973): Code of safety for phosphoric acid [CHD 8: Occupational Safety, Health and Chemical Hazards]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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IS : 6818 - 1973

Indian Standard
**CODE OF SAFETY FOR
PHOSPHORIC ACID**
(First Reprint SEPTEMBER 1982

UDC 614.878:661.634.2



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**INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002**

**AMENDMENT NO. 2 DECEMBER 2006
TO
IS 6818 : 1973 CODE OF SAFETY FOR
PHOSPHORIC ACID**

[Page 4, *clause 3.1(h)*] — Insert the following after (h):

j) TLV-STEL — 3 mg/m³

(Page 5, *clause 4.4*) — Insert the following new clause after **4.4**:

'4.5 Incompatible — Phosphoric acid can react violently with sodium tetrahydroborate; undergoes exothermic reactions with aldehydes, amines, amides, alcohols and glycols, azo-ompounds, carbamates. esters, caustics, phenols and cresols, ketones, organophosphates, epoxides, explosives, combustible materials, unsaturated halides, and organic peroxides. Phosphoric acid forms flammable gases with sulphides, mercaptans, cyanides and aldehydes. It also forms toxic fumes with cyanides, sulphide, fluorides, organic peroxides, and halogenated organics. Mixtures with nitromethane are explosive.'

AMENDMENT NO. 1 MARCH 2002
TO
IS 6818 : 1973 CODE OF SAFETY FOR PHOSPHORIC
ACID

(Page 4, clause 3) — Insert the following new clause after **3** and renumber **3.1** as **3.2**:

'3.1 General Properties

3.1.1 Common Names — Phosphoric acid, ortho-phosphoric acid.

3.1.2 Chemical Names — Phosphoric acid.

3.1.3 Molecular Formula — H_3PO_4 .

3.1.4 U.N. Number — 1805.

3.1.5 CAS Number — 7664-38-2'.

(Page 9, clause **10.2.4**, line **9**) — Insert the following sentence after the word 'hear':

'If electrical exhaust blowers are used, its motor must have flame proof fittings'.

(Page 9, clause **10.4.3**) — Insert the following at the end

'If the tank is rubber lined, care should be taken to avoid any unwanted Are inside the tank due to presence of rubber lining, when welding work is done outside the tank.'

(CHD 7)

Indian Standard

CODE OF SAFETY FOR PHOSPHORIC ACID

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(Continued on page 2)

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Indian Standard

CODE OF SAFETY FOR PHOSPHORIC ACID

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 30 January 1973, after the draft finalized by the Chemical Hazards Sectional Committee had been approved by the Chemical Division Council.

0.2 Phosphoric acid is a widely used common inorganic acid. Fertilizer industry is the biggest consumer of phosphoric acid. In its pure form, it is used in cosmetic, pharmaceutical, detergent, food and various other industries. The phosphoric acid used is mainly orthophosphoric acid; but condensed acids of the general formula $H_{n+2} P_n O_{3n+1}$ also are being used progressively.

0.2.1 The strength of phosphoric acid is generally expressed in terms of phosphoric pentoxide (P_2O_5) content. The strength of commercial grade acids varies from 20 to 85 percent P_2O_5 . Acids, above 65 percent P_2O_5 content, invariably contain condensed phosphates.

0.2.2 Phosphoric acid produced by wet process contains fluorine compounds, either as hydrofluosilicic acid or hydrofluoric acid in varying ratios. The fluorine content of the acid is generally controlled by factors such as the nature of the ore used, the process of acid extraction, the method of cooling employed during processing.

0.3 In the preparation of this standard considerable assistance has been derived from MCA Safety Data Sheet No. SD-70 'Phosphoric acid' issued by Manufacturing Chemists' Association Inc, Washington DC, USA.

1. SCOPE

1.1 This code describes properties of phosphoric acid, the nature of hazards associated with it and essential information on storage, handling, packing, labelling, disposal of waste, cleaning and repair of containers, selection and training of personnel, protective equipment and first aid.

1.1.1 This code does not deal with specification for design of buildings, chemical engineering plants, storage vessels, equipment for operations control and waste disposal.

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2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 4167-1966* and IS : 4155-1967† shall apply.

3. PROPERTIES

3.1 Some of the important physical properties of phosphoric acid are given below. Unless specifically noted, the values given are for 100 percent acid:

- | | |
|---|--|
| a) Physical state.: | |
| 1) Anhydrous orthophosphoric acid (H_3PO_4) | Solid |
| 2) 70 to 85 percent solution containing 54 to 60 percent P_2O_5 | Viscous liquid |
| b) Colour | Water white liquid/translucent solid |
| c) Corrosivity of solutions | Very corrosive to ordinary ferrous metals and alloys, particularly when hot |
| d) Density at 15.5°C: | |
| 1) 75 percent solution | 1.583 |
| 2) 85 percent solution | 1.694 |
| e) Vapour pressure at 20°C. | 0.028 5 mmHg |
| f) Flammability | Non-flammable. On reaction with metals releases hydrogen which is highly flammable |
| g) Melting point | 42.4°C |
| h) Boiling point (H_2PO_4) | 260°C approximately |

4. HAZARDS

4.1 Hazards encountered with phosphoric acid are health hazards and very rarely explosion and fire hazard. Harmful effects are caused from daily exposures to unsafe concentrations over a prolonged period. The

*Glossary of terms relating to air pollution.

†Glossary of terms relating to chemical and radiation hazards and hazardous chemicals.

threshold limit value (TLV) (as accepted by American Conference of Governmental Industrial Hygienists, USA) of phosphoric acid is 1 mg per cubic metre of air for 7 to 8 hours work-day and 40 hours work-week.

4.2 Acute poisoning results from oral intake and from repeated and continued inhalation of the vapours emitted from the acid.

4.3 Contact with the acid produces irritation. The presence of fluorine compounds causes ulceration which heals only slowly.

4.4 The acid on coming into contact with metals liberates hydrogen which is highly flammable.

5. HANDLING AND STORAGE

5.0 General — All preventive measures given in 7 shall be taken while handling and storing phosphoric acid in various containers.

5.1 Usual shifting containers are boxed carboys, fibre drums for liquids, metal drums of stainless steel or rubberlined carbon steel. Tank cars or tank trucks are also fabricated from stainless steel or rubberlined carbon steel.

5.2 Corrosion — Phosphoric acid attacks many metals, but it can be stored satisfactorily in rubberlined steel or stainless steel tanks designed and fabricated for the purpose, or in the drums in which it is received. The corrosive properties vary with the concentration.

5.3 Drums — Drums should be stored with the plugs up and the storage period kept to a minimum.

5.3.1 Store drums away from heat and direct sunlight.

5.3.2 To release pressure which may build up, loosen plugs of stored drums weekly and more frequently in hot weather.

5.4 Carboys — Filled boxed carboys of phosphoric acid should not be tiered more than three carboys high. Empty boxed carboys should be stored on their flat side, not over four tiers high, in such a manner that the necks will not protrude into aisles or passageways.

5.5 Spillage — Phosphoric acid spills may be handled by flushing with plenty of water. Care must be taken to protect against prolonged contact with skin.

6. LABELLING

6.1 All containers of phosphoric acid shall bear an identifying label as depicted in IS : 1260-1973*. The lower half of the label shall have

*Pictorial markings for handling and labelling of goods: Part I Dangerous goods.

the following text:

PHOSPHORIC ACID

CAUTION: CAUSES SKIN IRRITATION. AVOID CONTACT WITH SKIN AND EYES. IN CASE OF CONTACT FLUSH SKIN OR EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES — GET MEDICAL ATTENTION.

7. PREVENTIVE MEASURES

7.0 The hazards of the phosphoric acid may be avoided by effective employee education, proper safety instructions, intelligent supervision and use of safety equipment.

7.1 Working places where phosphoric acid mist and fluorine vapours are expected to be present should be kept well ventilated by mechanical drafts.

7.2 In places where phosphoric acid is heated either for concentration or for processing, workers should be provided with gas masks.

7.3 Rags, clothing, etc, soaked in acid should be washed clean in water before using again.

7.4 The containers should be properly labelled and tightly closed.

7.5 Since phosphoric acid is highly corrosive to many metals and alloys, the proper designing and selection of handling, storage and process equipments should be done by chemical and safety engineers, skilled in the handling of acid.

7.5.1 Care shall also be taken that phosphoric acid is not left in unvented pipelines, as a measure of safety against pressure rupture.

7.6 Electrical fixtures where the acid is handled shall be as vapour-tight as possible to protect against the corrosive action of vapour. All wiring should be in tight, rigid conduits.

7.7 Employee education in respect of safety in phosphoric acid is an essential feature for a safe working condition. The employees should be educated, regarding the use of protective equipments, and the actions to be taken in an emergency. The employees should also be trained to report to the proper authorities in case of failures of equipment and machinery or at the time of emergency.

7.7.1 The protective equipments include chemical safety goggles, face-shields, respiratory equipments, skull guards, PVC or rubber gumboots, safety gloves, chemical-resistant aprons, etc. These equipments shall be kept well clean and at easily accessible areas. After use, these equipments shall be cleaned in water using soap or soda ash.

7.8 In case of fire fighting in phosphoric acid vicinity due to liberated hydrogen or otherwise, care must be taken to avoid exposure to fumes and vapours. Firemen should wear all-purpose canister type respirators. Where heavy concentrations over 2 percent by volume in air are suspected, self contained breathing apparatus shall be worn.

7.9 Air Analysis — For safe working in phosphoric acid, a knowledge of concentration of fluorine vapours and phosphoric acid in the atmosphere is essential.

8. MEDICAL EXAMINATION

8.1 All workmen, working on phosphoric acid should be regularly subjected to medical check-up by competent physician acquainted with occupational diseases. The workmen who have developed symptoms of poisoning by fluorine should be removed from the workspot and proper medical attention given.

9. FIRST AID

9.1 In the case of eye exposure, treatment should be begun immediately after flushing the eyes at least for 15 minutes with cold water. An eye-irrigation fountain is very effective.

9.2 In case the skin and mucous membrane are affected, remove contact and wash the affected portion with plenty of water.

9.3 In case of swallowing, administer plenty of water to reduce concentration of acid. Vomiting may be induced by having the patient stick his finger down his throat.

9.4 If a workman inhales large quantity of fumes or vapours, remove him to fresh air and, if necessary, artificial respiration should be administered. Administer oxygen whenever necessary.

9.5 In case of inhalation, swallowing or acute contact, administer calcium gluconate. In case of severe doses, an intravenous injection may be necessary.

NOTE 1 — As soon as first aid is given the attention of a physician is imperative,

NOTE 2 — Never administer anything orally when the patient is unconscious.

10. TANK CLEANING AND REPAIRS

10.1 Preparation of Tanks and Equipment

10.1.1 Tank and equipment cleaning should be done under the direction of trained personnel familiar with the hazards and the necessary safeguards.

10.1.2 Tanks and equipment, pumps, lines and valves should always be drained and thoroughly flushed with water before being repaired. Workmen should never be allowed to attempt to repair equipment while it is in operation and the lines full.

10.1.3 All pipelines to the tank should be disconnected, and all connecting lines should be blanked off.

10.1.4 The agitators, if any, should be disconnected or locked off.

10.1.5 If pipe sections are to be removed and flanges opened, the lower bolts should be loosened first and although the lines have been flushed, care should be taken to avoid personal contact with the liquid draining or dripping from the equipment. All spillage from the lines or equipment should be removed immediately by flushing to the drain with large quantities of water.

10.1.6 Due to its ready dilution by water and its low vapour pressure, tanks or equipment should be so cleaned of phosphoric acid that there is little chance of exposure to hazardous vapours. Despite this, however, consideration should be given to the instructions laid down in **10.2**, **10.3** and **10.4** as a guide to safe tank and equipment cleaning and repairs.

10.2 Entering Tank

10.2.1 No one should enter a tank or confined space until a work-permit has been signed by an authorized person indicating that the area has been tested and found to be safe. Furthermore, no workman should enter a tank or vessel that does not have a manhole opening large enough to admit a person wearing a safety harness, life line, and emergency respiratory equipment. It should be ascertained that the tank or vessel can be left by the original entrance.

10.2.2 One man standing outside the tank should observe the activities of men inside the tank and another should be available nearby to aid in rescue, if any of the men in the tank is overcome by fumes.

10.2.3 A supplied-air respirator or self-contained breathing apparatus, together with rescue harness and life line, should always be located outside the tank entrance for rescue purposes, regardless of the type of respiratory equipment or air supply which is provided for employees inside the tank.

10.2.4 Special ventilation is recommended during the entire period, the men are engaged in cleaning, repairing, or inspecting the tank. Ventilation can be accomplished by exhausting or removing vapours from the bottom of the tank either through its bottom openings, or by exhausting the vapours from the tank bottom by means of a large flexible duct where tanks have a top opening only. As a precaution against the ignition of existing hydrogen, the blowers or air movers used for ventilation of oxygen should be cleaned frequently so that moving parts will not set up friction heat. In tanks having only a top opening, care shall be exercised to ensure complete removal of vapours from the entire tank. Care shall also be taken to avoid having exhaust gases recycled into the tank.

10.2.5 In all cases, if repair work is interrupted, the tank atmosphere should be checked thoroughly and a new work-permit issued before resumption of work.

10.3 Emergency Rescue — Under no circumstance should a rescuer enter a tank to remove a victim of overexposure without proper respiratory protection, a safety harness and an attached life line. The free end of the life line should be manned by an attendant standing outside the tank. Another attendant should be immediately available to assist in the rescue, if needed. The rescuer should have a view of the outside attendant at all times or in constant communication with him.

10.4 Exterior Repair Work

10.4.1 Exterior tank repairs, including repairs of steam coils, cutting, riveting and welding, should be permitted only after thorough cleaning and testing of the tank to make sure it is free from vapours and after a work-permit has been issued by an authorized person. Repeated tests with an approved combustible gas indicator should be made to fully protect workmen.

10.4.2 All outside welding or burning on tanks or equipment, which have contained phosphoric acid, should be done only after such containers have been completely purged with steam. Purging should be continued while the repair work is in progress. Filling clean, empty tanks with inert gas is another method which may be used in outside welding or burning.

10.4.3 In all cases, if repair work is interrupted, the tank atmosphere should be checked thoroughly and a new work-permit issued before resumption of work.

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Base Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>	<i>Conversion</i>
Force	newton	N	1 N = 1 kg.1 m/s ²
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m ²
Frequency	hertz	Hz	1 Hz = 1 c/s (s ⁻¹)
Electric conductance	Siemens	S	1 S = 1 A/V
Pressure, stress	pascal	Pa	1 Pa = 1 N/m ²

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